

2nd Annual Safety and Cultural Heritage Summit 2018
Preserving Our Heritage and Protecting Our Health

**Uses of Ionizing Radiation for Tangible
Cultural Heritage Conservation**

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Washington, D.C.

November 7th

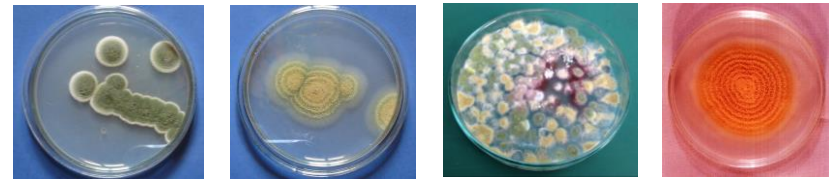
Ionizing Radiation (gamma rays) for Processing for Cultural Heritage

Most attention in preventive conservation has been paid to the chemistry of indoor environment and the reactions that may occur indoors.

Despite much work has been done, it is still necessary to increase knowledge on the advantage and limitations of nuclear technology for this kind of application.

One of the threats to our tangible cultural heritage is the destruction by mold and insects. Besides the destruction of the materials, there is also a risk for occupational health, the toxicity of materials and environmental pollution.

- Mold can cause infections and allergic reactions
- Some fungi are even carcinogenic (*Aspergillusflavus*)
- Often used disinfection systems for large stabilizations are ethylene oxide (EtO) and gamma radiation
- EtO is toxic for humans and materials processed
Hengemile, Weberg, and Shahani (1995)
Havermans and de Bruin (2007)
- Materials treated with gamma radiation are non toxic and was found to be a good alternative for disinfection
- Gamma is an efficient instrument and used for 50 years for the sterilization of medical supplies
- Gamma is becoming a method of choice in disasters and mass treatments without the use of chemicals
- Ionizing radiation disinfection is inexpensive, easy to use and cost-effective

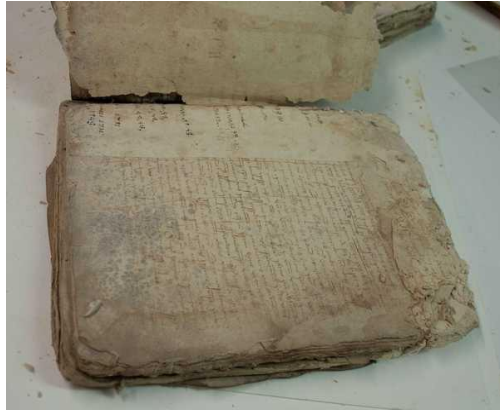


Mold samples from Colombia and Cuba

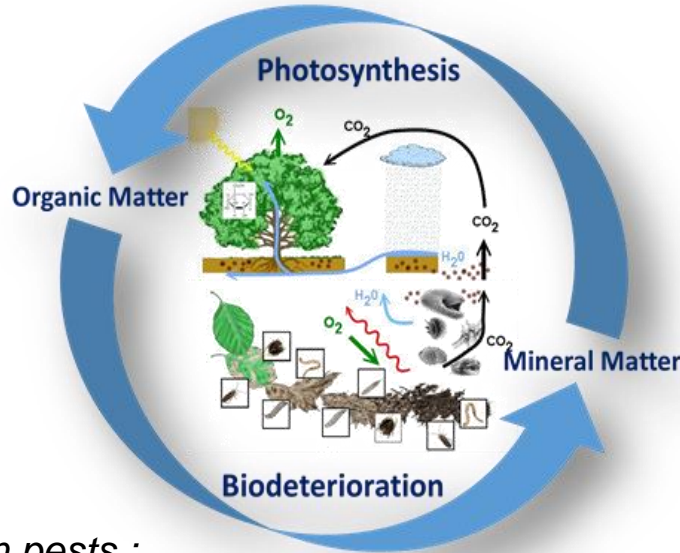


Insect eradication by gamma irradiation, apostles and angels, 17th c., Le Pague

Disinfestations: Radiation to Fight Against Bio-Deterioration



by simple gamma ray exposure

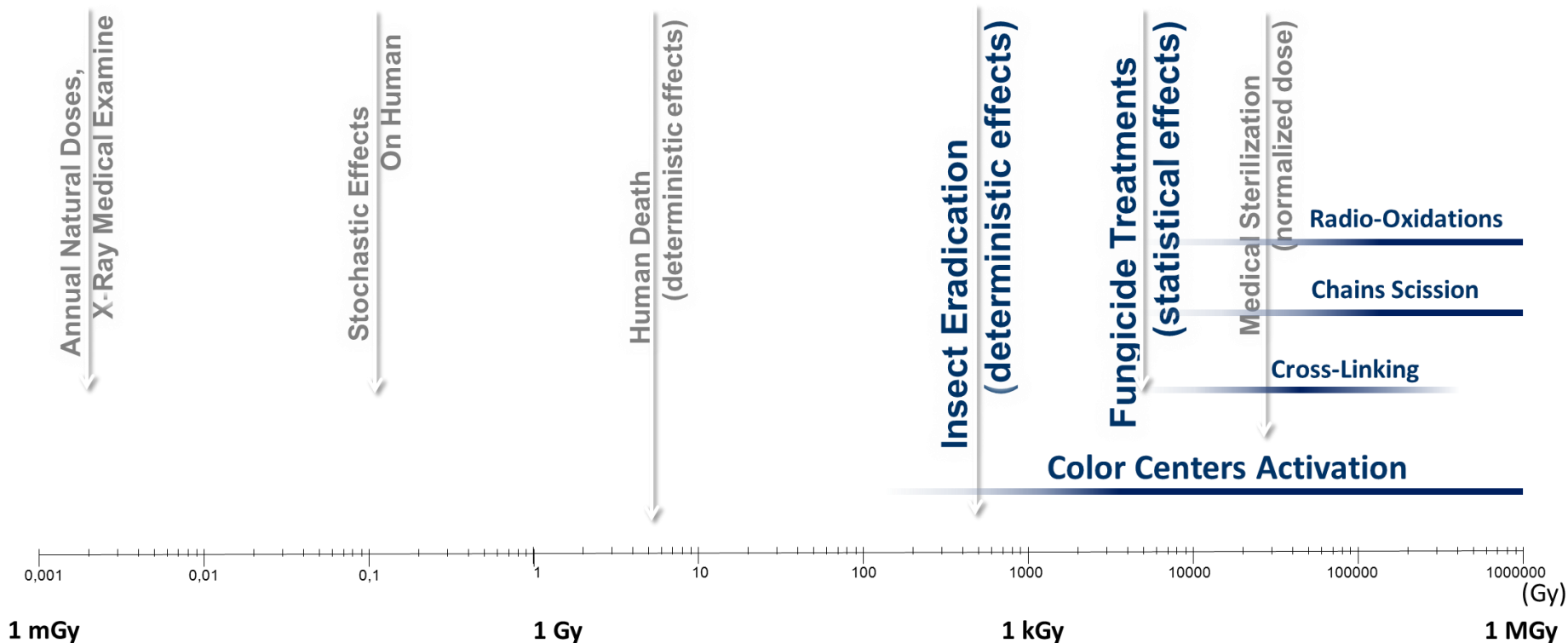


Main pests :
Fungi (mold, rot) and insects



Biocidal Effect vs Harmlessness: A Matter of Dose

High dose from biological point of view are still low to moderate from material point of view. Only definitive contraindication is irradiation of bulk transparent material that can change of color due to activation of color center.



When addressing paper-based collections and ink corrosion, the latest research showed that lowering the dose of the disinfection treatments (8 ± 2 kGy) is efficient to reduce enough mold and spores in accordance with conservation standards, while potential side effects are reduced to a minimum.

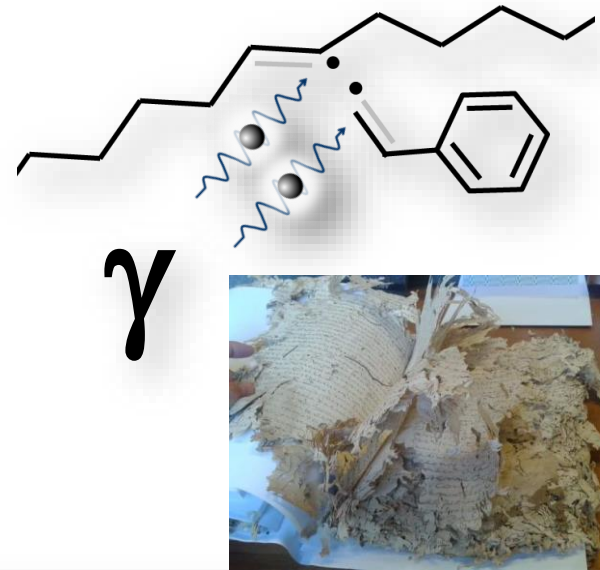
Radiation Processing for Cultural Heritage Conservation

Bio-deteriogen Eradication vs Consolidation and Protection of Porous Wood and Stone

Biocide treatments due to the action of ionizing radiation on molecules implied in life



Consolidation treatments using radiation curable resin after impregnation of porous material (in situ polymerization of the resin triggered by ionizing radiation)



French Archives Nationales

Parquet Hotel Lesdiguière, 18^e c., Grenoble
Musée Dauphinois, Grenoble

Gamma Biocide Treatments

Applicable on a very large range of organic materials and mass contaminations.
The most popular applications of gamma radiation are:

10,000 cubic meter treated since the 70's

- *Furniture*
- *Paper*
- *Books*
- *Leather*
- *Textiles*
- *Wooden Sculptures*
- *Ethnological Objects*
- *Musical Instruments*
- *Artworks*
- *Taxidermy*
- *Modern Art*



Some "exotic" "clients"

(frozen baby mammoth and mummies)



Publication

Uses of Ionizing Radiation for Tangible Cultural Heritage Conservation ***International Atomic Energy Agency (IAEA)***

Radiation Technology Series Nr. 6, STI/PUB/1747, ISBN 978–92–0–103316–1
(2017).

The first comprehensive publication on the subject

- *Interdisciplinary approach*: scientific and methodological background, related physics, chemistry, biology, engineering, ethics, and equipment
- *Critically approach*: pros & cons, limits, and circumstances for application
- *Various examples of case studies and treatments around the world support theory*
- *A language understandable* by all actors of this interdisciplinary area; while technical chapters were written by physicists, chemists, and engineers and others dedicated examples were presented by end-users
- Irradiation is being used in many countries: Argentina, Brazil, Croatia, Czech Republic, France, Holland, Italy, Mexico, Poland, Portugal, Romania, Serbia, Tunisia and USA

<https://www-pub.iaea.org/books/iaeabooks/10937/uses-of-ionizing-radiation-for-tangible-cultural-heritage-conservation>

Disasters' Interventions and Free of Contaminants

Flood in Brazil and War in Croatia



Interventions in Large Quantities

Footwear from Majdanek Concentration Camp - Poland



Intervention of a Large Church Altar Monastery of Izvoarele, Prahova - Romania



Interventions of Modern Sculptures

L. Mogosanu, Nicapetre
Romania



<https://www.youtube.com/watch?v=ePiNdzWjoWM>

THANKS

*“If you want to go fast, you go alone.
If you want to go far, you go together.”*
(Old African Proverb)